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(NASA-CR-183426) MISSION OPERATIONS AND  
DATA SYSTEMS DIRECTORATE'S  
OPERATIONAL/DEVELOPMENT NETWORK (MODNET) AT  
GODDARD SPACE FLIGHT CENTER Final Report  
(BMS Technologies) 47 p

N89-25763

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CSCL 05A G3/81 0169874

**FINAL REPORT**  
**FOR THE**  
**MISSION OPERATIONS AND DATA SYSTEMS DIRECTORATE'S**  
**OPERATIONAL/DEVELOPMENT NETWORK**  
**(MODNET)**  
**AT**  
**GODDARD SPACE FLIGHT CENTER**

Contract No. NAS5-30168



October 1988



**TECHNOLOGIES, INC.**

8201 CORPORATE DRIVE SUITE 500 LANDOVER, MARYLAND 20785

(301) 459-8981

October 31, 1988

National Aeronautics and Space Administration  
Goddard Space Flight Center  
Greenbelt, MD 20771

Attention: Ms. Sandra McKercher  
Contract Specialist  
Code 285

Reference: Contract NAS5-30168

Dear Ms. McKercher:

In accordance with Article F-6, Reports of Work, attached please find the Final Report for the Mission Operations and Data Systems Directorate's Operational/Development Network (MODNET).

If you have any questions or suggestions regarding this report, please contact me at (301) 794-3408.

Very truly yours,

A handwritten signature in black ink, appearing to read "W. I. Lawler". The signature is fluid and cursive, with a long horizontal stroke at the end.

William I. Lawler  
MODNET Project Manager

cc: Mr. Steven A. Smith (5)  
Code 541.2

Date Submitted: October 31, 1988

Report No. 16

**FINAL REPORT  
FOR THE  
MISSION OPERATIONS AND DATA SYSTEMS DIRECTORATE'S  
OPERATIONAL/DEVELOPMENT NETWORK  
(MODNET)  
AT  
GODDARD SPACE FLIGHT CENTER**

Contract No. NAS5-30168

RMS Technologies, Inc.  
8201 Corporate Drive, Suite 500  
Landover, Maryland 20785

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## **I. PROJECT MANAGEMENT**

The Project Manager's efforts during the initial stage of the Mission Operations and Data Systems Directorate's (MO&DSD) Operational/Development Network (MODNET) contract focused on reviewing contract requirements and deliverables; establishing the office areas; and arranging for the acquisition of furniture, fixtures, equipment, and supplies necessary for contract startup.

He worked with Metro-Plex II building management to resolve initial office construction problems, and communicated with American Telephone and Telegraph Company (AT&T) to finalize the installation of voice and data telephone lines and equipment.

The Project Manager was responsible for the procurement of all equipment and supplies required for the timely implementation of the network, and spent a considerable amount of time compiling an extensive updated listing including the Government Services Administration (GSA) six percent discounted prices of the equipment to be purchased from Network Systems Corporation (NSC).

He established and conducted a weekly staff meeting as a forum for the review of work in progress, discussion of current problems and possible solutions, and formulation of plans for the future. All RMS MODNET personnel attended these Monday morning meetings.

He attended the biweekly MODNET Working Group (MODNETWG) meetings and completed designated action items. He also attended the Mid-Atlantic

Regional NSC User's Group (NEXUS) Conference that was held at the National Bureau of Standards in Gaithersburg, Maryland.

The Project Manager, in his role as Hardware System Engineer, attended an NSC E5000 Series Network Executive (NETEX) Software Course at the NSC Training Facility in Minneapolis, Minnesota. The E5000 Series course covered the NETEX family of software products and related HYPERchannel hardware, which included an indepth look at NETEX and Bulk File Transfer (BFX) plus associated hardware, usage, and design issues. Course Modules E5210 - NETEX for IBM MVS, E5211 - BFX for IBM MVS, and E5260 - NETEX for DEC VMS described how to use and install NETEX on the related system.

In addition to his role as Project Manager, he utilized his extensive hardware system engineering expertise to give direct hands-on support to the MODNET Hardware Engineering Technicians for installation and maintenance work being performed, acceptance testing of network adapters and associated equipment, and the development of data bases in addition to planning, scheduling, coordinating, and implementing the hardware installations for the following:

- Fourteen Network Adapter Systems including spare A901 and A223 Systems
- Eight Fiber Optic (FO) Repeaters including two spares
- All 1,624 feet of coaxial cable on eight floors of Buildings 3, 14, and 23 for the connection of 12 Adapter Systems with their HOST Systems to the completely new TESTLAN 2 Trunk

- The expansion of HIGHWAYS 0 Trunk with 926 feet of coaxial cable to accommodate connecting 10 additional Adapter Systems to this Trunk in Buildings 3 and 23
- The expansion of HIGHWAY 1 Trunk with 1,047 feet of coaxial cable to accommodate connecting 10 additional Adapter Systems to this Trunk in Buildings 3 and 23
- The expansion of InfoLAN 2 Trunk with 177 feet of coaxial cable to accommodate connecting three additional Adapter Systems to this Trunk in Building 23.
- The expansion of InfoLAN 3 Trunk with 489 feet of coaxial cable to accommodate connecting eight additional Adapters to this Trunk in Building 23.

He was also instrumental in the formulation of a plan for testing the fiber optic repeaters and cables, and the development of a Changeover Plan for the fiber optic repeaters and cables. Separate Changeover Plans for fiber optic cables and repeaters were developed for MODNET Highway Trunks 0 and 1, and for TESTLAN Trunk 2. The purpose of the Changeover Plans for Highway Trunks 0 and 1 was to document the actions to be taken to replace the aged and weathered interbuilding coaxial cable segments of the trunks with new, already in place and tested, fiber optic trunk segments. The purpose of the Changeover Plan for TESTLAN Trunk 2 was to document the actions that needed to be taken in order to link the two intrabuilding coaxial TESTLAN 2 sections via the interbuilding fiber optic TESTLAN section.

He was also responsible for the development of six data bases of MODNET hardware/software configuration information for use in system configuration management (refer to Appendix A) and the cable layout diagrams of the MODNET Trunks (refer to Appendix B).

The Project Manager significantly contributed to and extensively reviewed all contractually-required MODNET documentation.

Equipment Purchase Order (PO) activity during September 1988 consisted of the following:

- Purchase Order Number 18193 to Network Systems Corporation (NSC) which completes the procurement requirements for spare parts equipment and network monitoring software. (See Attachment 1.)
- Modification to PO Number 18109 for MODNET test equipment being purchased from Tektronix, Incorporated, after Tektronix added the equipment involved to their Goddard Space Flight Center (GSFC) discount list. (See Attachment 2.)
- Purchase of 3280 HEP Diagnostic Programs from Informax Data Systems, Incorporated (IDS). (See Attachment 3.)
- Purchase of 32/77 HEP Diagnostic Programs from IDS. (See Attachment 4.)

Figure 1 depicts the GSFC MODNET Milestone Schedule for the complete contract period.





## II. NETWORK HARDWARE/SYSTEMS ENGINEERING

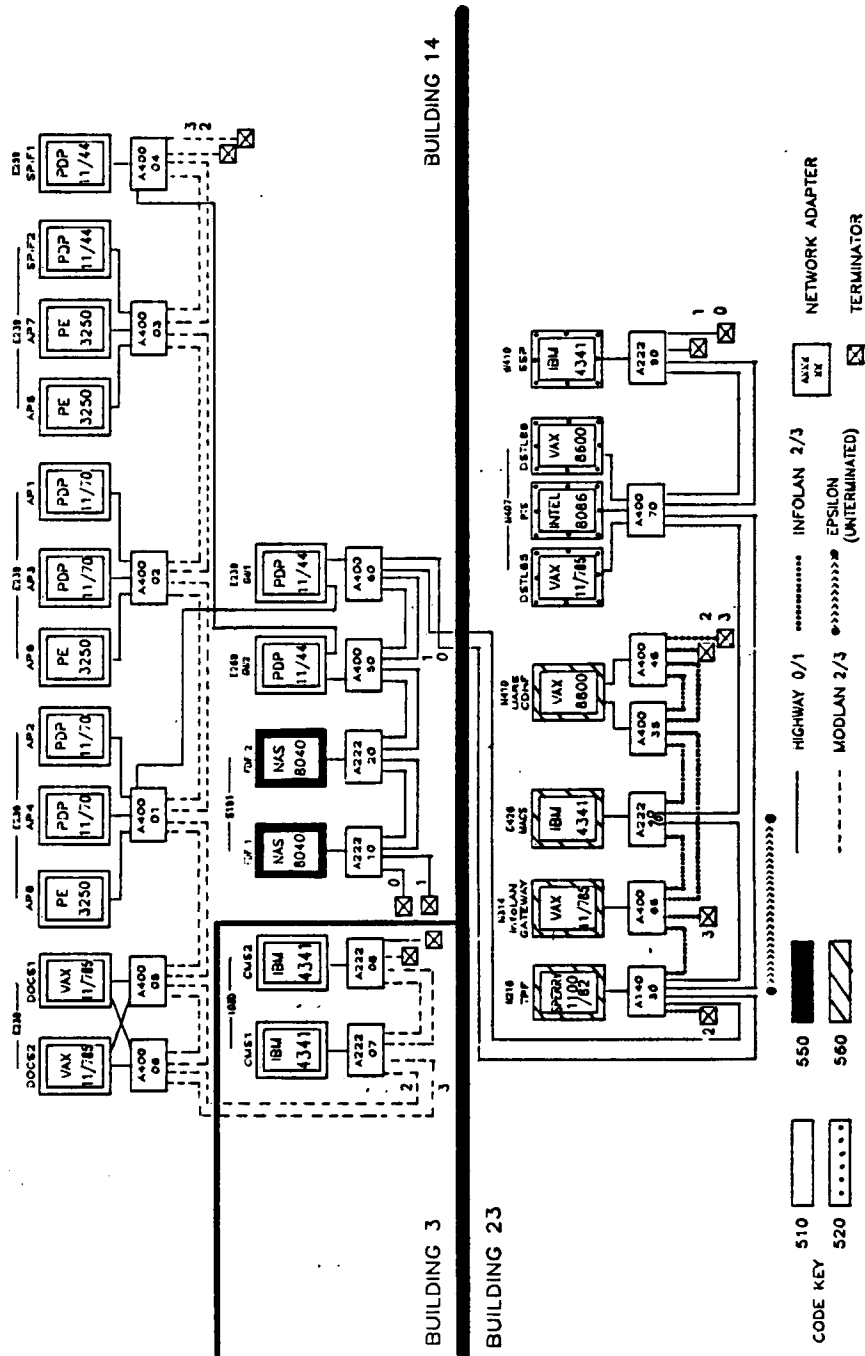
During the initial stage of MODNET operations, the hardware engineering technicians assisted the RMS Technologies, Inc. (RMS) Engineering and Technical Support (ETS) personnel for Codes 520 and 550 in the performance of monthly and weekly preventive maintenance on network adapter units 10, 20, 30, 40, 50, 60, 70, and 90. They also responded promptly to users reporting problems with network adapters. However, during the period October 1987 through September of 1988, the RMS/MODNET hardware engineering personnel performed all preventive and remedial maintenance for the MODNET HIGHWAY, TESTLAN, and InfoLAN Trunks' Adapters.

The task of measuring and verifying trunk cable lengths and types of cables between the eight Mission Operations and Data Systems Directorate Network (MNET), three Information Processing Division Local Area Network (InfoLAN); and eight Mission Operations Division Local Area Network (MODLAN) adapter systems was completed. Both ends of the many different cables were relabeled as required. An inventory listing of all printed circuit boards (PCB) in all MNET, InfoLAN and MODLAN adapters was prepared. The list includes part numbers, serial numbers, and revision levels for all the PCBs.

The updated diagrams of the MODNET Functional Baseline Configuration and Operational Baseline Configuration, were completed. The task was complicated by many changes in trunk layout and host computer systems. The diagrams were updated throughout the term of the contract, and current revision

levels of the configuration diagrams are included as Figure 2 and Figure 3 of this report.

# MODNET FUNCTIONAL BASELINE CONFIGURATION



REVISION 1 SEPTEMBER 28, 1987

Figure 2. MODNET Functional Baseline Configuration

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# MODNET OPERATIONAL BASELINE CONFIGURATION

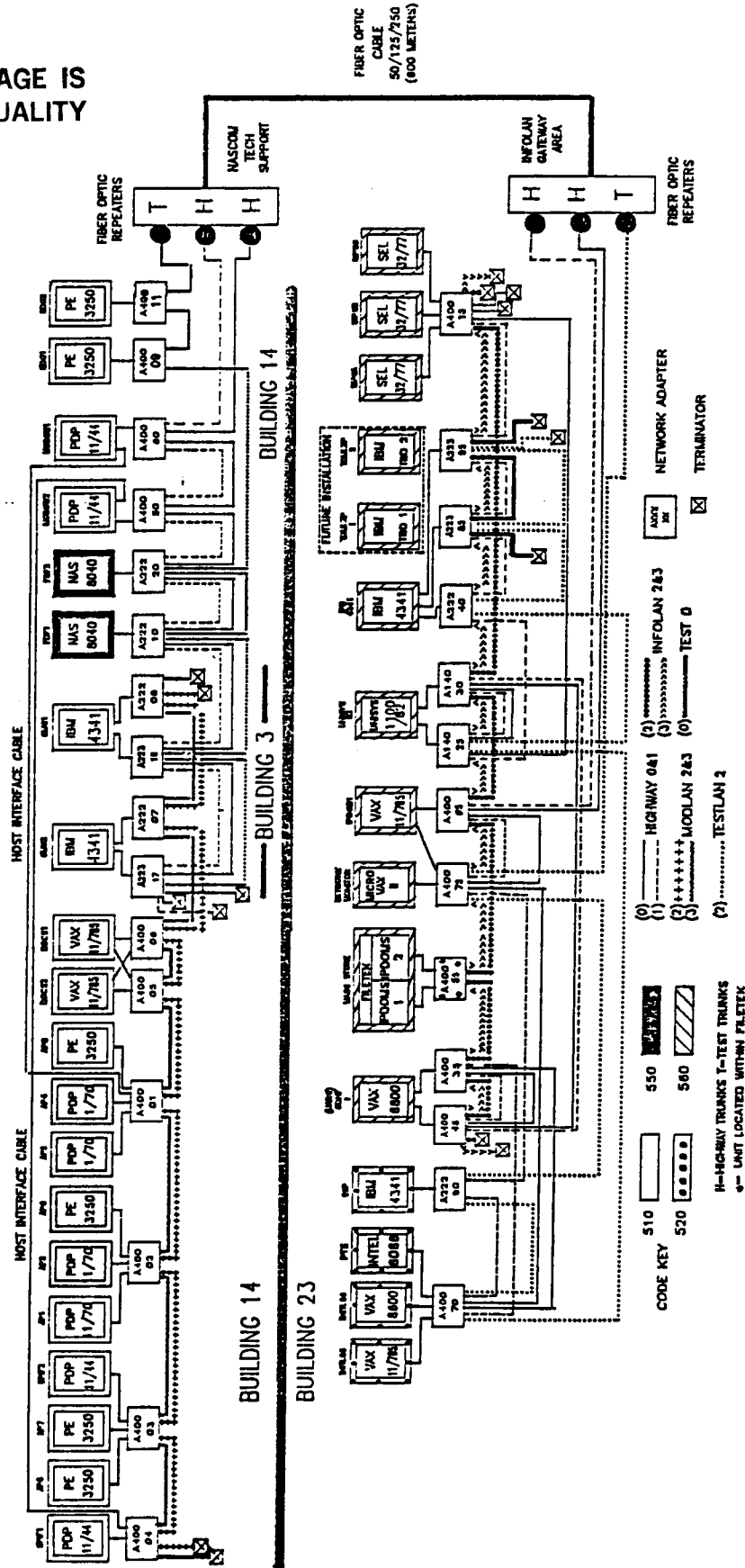


Figure 3. MODNET Operational Baseline Configuration

A member of the Network Hardware/Systems Engineering staff attended an NSC E1000 Hardware Maintenance Training Course in Minneapolis, Minnesota during the period of June 2 through June 11, 1987. Course material included functional descriptions of several adapters including A222, A400, A223, and A140; a brief explanation of board locations, registers, cables, and power supplies (positive and negative); instructions on the use of specialized test equipment including the NMC3 tester and PC terminal; and hands-on troubleshooting techniques. The course also covered the AC715 communications of the link, as well as the installation of all units.

An inventory checklist of the hardware and software that was being received from NSC was established and implemented. Part Numbers, NASA Numbers, Manufacturers' Serial Numbers, and Revision Levels were verified and documented. The inventory continued as additional equipment was received throughout the life of the contract.

Part Numbers, Revision Levels, and Serial Numbers for all PCBs in the existing network adapters were recorded and verified. PCBs for several adapters were not at current Revision Levels, and replacement of microcode was begun. Revision Levels of PCBs were modified in response to Field Change Orders (FCO).

The Hardware Engineering Technicians installed splices and ends on the new Comm/Scope trunks in Building 23 using 15 Comm/Comm splices, 18 Comm/N-type ends, and 2 N-type splices. In addition, drop cables were fabricated and Comm/Scope cables were installed with connectors in various

locations in Buildings 3, 14, and 23 as new trunk segments for the TESTLAN Trunk and as new expansion trunk segments for the two Highway Trunks.

ANDS and WRAP diagnostic testing was performed on System Development Facility network adapter units 9 and 11 to confirm proper operation for the scheduled fiber optic testing. All tests ran successfully. In addition, adapter units 9, 11, and 65 were used to test six ATR2 fiber optic repeaters using WRAP, HIT, and HEP diagnostics. All tests were completed without failure.

Three fiber optic trunk segments going between Buildings 14 and 23 were tested successfully utilizing a special test configuration of adapters 9 and 11 in Building 14 and adapter unit 65 in Building 23. The trunk segments were composed of fiber optic cable with ATR2 fiber optic repeaters at each end. A total of six ATR2 repeaters and three pairs of fiber optic cable were tested successfully with HEP and WRAP diagnostics running consecutively.

The Hardware Engineering Technicians worked with NSC personnel to perform the wiring, installation, and testing of 26 new AD8E trunk PCBs in 14 different network adapters.

All told, the RMS/MODNET hardware engineering personnel installed and/or reconfigured a total of 4,263 feet of coaxial trunk cable, 56 Adapter System connections to MODNET Trunks, 14 Network Adapter Systems and 8 FO Repeater at GSFC in Buildings 3, 14, and 23 during the MODNET contract.

During September 1988, prior to receiving maintenance responsibilities for the MODLAN Adapter Systems, the RMS/MODNET engineering technicians

upgraded seven MODLAN A400 Adapter Systems (Unit 01 through 06 and the spare unit) as follows:

- On the AD7E Microprocessor Board P/N 200135-01, the A400 Microcode P/N 216091 was upgraded from revision level 42 to revision level 50.
- The AD5E Extension Register/DMA Board P/N 200166 was upgraded from revision level 03 to revision level 04.
- The AD400-2A Host Interface Board P/N 200020 was upgraded from revision level 02 to revision level 03.

After the upgrades were installed, each Unit was tested successfully with HEP diagnostics.



### **III. NETWORK SOFTWARE/SYSTEMS ENGINEERING**

The Network Software/Systems Engineering Section performed cost trade-off and design studies, software procurement, network software installation, test software development, and system integration/acceptance testing. These and installation of the NMS3 network monitor areas are discussed in the following sections.

Cost trade off/design studies: Three studies were performed by the Software/Systems Engineering Group:

- Software Lease vs. Purchase
- Gateway Replacement
- Network Monitoring

For the Software Lease vs. Purchase study, the Software Section used the GSA schedule to determine the lease and purchase costs of NETEX and BFX software for MODNET, including the one-time initial charge, for the projected 10-year life cycle of the Project. The multiple copy discount were included; free software maintenance in included with the lease. The purchase cost was based on the one-time purchase cost, including multiple copy discount, and a monthly software maintenance charge (CSS) for the 10-year period. The break-even point was in the 6th year, making the software purchase more cost effective.

In October 1987, the MODLAN subnetwork agreed to consider alternatives to the DEC PDP/11 Gateway computers that separate MODLAN from the MODNET subnetwork. The Software Section developed five alternate configurations using the NSC A710 and AC715 link adapters. These devices would provide message filters while providing high-speed communications between the subnetworks. After due consideration, MODLAN decided to keep the Gateway computers to provide complete electronic separation between the subnetworks and to route data traffic on the real-time and non-real-time sessions with the Flight Dynamics Facility (FDF).

In November and December 1987, a network monitor study was conducted to determine if the available network monitor satisfied the MODNET monitoring requirement and, if so, to schedule the purchase of the monitor. An earlier network monitoring study was obtained from the Defense Communication Agency (DCA) through the Local NEXUS organization. The MODNET study focused on the NSC NMS3 network management system and the HYPERtools Monitoring Device. The study concluded that the NMS3 provided the real-time monitoring support specified in the MODNET Requirements Document. The NMS3 was purchased with the understanding that NSC would be providing substantial functional and reporting features in the near future.

The HYPERtools analyzer was placed on the list of desirable future purchases. This analyzer provides an in-depth look at trunk performance and will be useful for future trunk usage and performance studies.

Software Procurement: Upon completion of the Lease vs. Purchase study, a purchase order for 30 NETEX and 18 BFX products was submitted. This procurement included NETEX and BFX for IBM MVS, DEC PDP, DEC VAX, UNISYS 1100, Perkin-Elmer 3250, and Gould SEL 32/77 computers. The NETEX purchase for all except IBM and UNISYS included Driver software.

The delivered software included base tapes and service level tapes for each product, as well as the general purpose manual which is delivered with each product. NSC also authorized GSFC/RMS to make duplicate copies of these manuals for the purpose of developing a MODNET library. All products and service levels were recorded in the MODNET software database.

Network Software Installation: NETEX and BFX were installed on each host system by the MODNET software engineer and the designated systems programmer for each host. This combination proved successful in combining NETEX and local system knowledge. As each system was installed, it was tested using BFX for both intrahost and interhost tests.

NETEX and BFX on IBM hosts were installed using SMP/4, SMP/E, or load module transfer. DEC VAX hosts proved the easiest to install, although the accidental deletion of an empty data set caused delays in one VAX installation. The Gould SEL computers have a Level-1 NETEX which is delivered as a subroutine library. This NETEX/BFX was easily installed but required an extensive effort to get it to work.

Due to the size of the network, a master network control table (NCT) was developed to verify the connectivity of all hosts. The operational NCT was tailored from the master NCT to reflect only those remote hosts with which each host will communicate.

Test Software Development: The MODNET programmer/analyst developed two test programs to test and demonstrate satisfaction of the MODNET performance and session capacity requirements. The SINGLE program opened one session and transferred data to a matching SINGLE program on the same host or another host. The tester responded to menus to specify the number and size of records to be transmitted and the number of iterations of the test to be performed. Test results were printed at the terminal and/or to a test log.

The test program MULTPL opened 28 sessions between 2 copies of the test program on the same or remote hosts. As with the SINGLE program, the tester was prompted for number of records, record size, and iterations. The aggregate test results and results for each session were printed at the terminal.

BFX was also used for performance testing using a file of 1,000 records of 4,068 bytes in length. The 4,068 byte length was selected due to the 28-byte BFX overhead and the 4,096-byte buffer size used for network testing.

Systems Integration/Acceptance Testing: Initial systems integration testing was performed using BFX on all hosts to establish and confirm connectivity between hosts. Performance testing was initially performed as planned with the SINGLE program with parallel testing with BFX. Due to subsequent problems in testing the 28-session capacity tests, the remaining performance tests were completed using BFX. A test matrix was developed to record performance tests between each host and all other hosts.

Although the requirement was simply to demonstrate that each host NETEX could achieve 500 kilobits per second, this extended test was selected to demonstrate the stability and robustness of the network.

After extensive program changes to the MULTPL program, it was determined that NETEX buffer and control region resources were the major cause of the capacity test failures. By modifying the NETEX parameters on each host, the capacity tests were successfully completed on all hosts that permitted the parameter changes. The result of this change was a substantial increase in the amount of real memory used by NETEX. The NETEX region size on the IBM hosts increased to 2.5 Megabytes. All parameters were restored to their original values after completion of the capacity tests.

Acceptance testing was completed with a stress test in which over 1,000 sessions were opened and 1,000,000 records were transmitted in 3-1/2 hours. This test demonstrated the robustness of the network.

Network Monitor Installation: The Software Section was also responsible for the installation and testing of the NMS3 network monitor. The NMS3 was physically installed by NSC and RMS maintenance personnel. NSC personnel installed the network monitor software. The Software Section worked with NSC personnel to develop the monitor NCT and the monitor configuration file which produces the Graphics Display Facility (GDF) display on the Tektronix 4105A display screen. The initial monitor software was Release 1.01 which is a Level-1 NETEX. In September 1988, NSC installed Release 1.10 which is a Level-2 NETEX. The monitoring software provides an accurate status of the network, although the recently installed Release 1.10 does appear to have some errors. This Release was initially installed as a pre-release with patches installed by NSC. The production release will be installed when available, and the monitor will be re-evaluated.

#### **IV. DOCUMENTATION**

Immediately after contract startup, the Documentation Specialist reviewed the list of contractually-required deliverables for the term of the contract, set up the work area, and established MODNET Documentation Procedures.

The MODNET Work Breakdown Structure (WBS) was updated to reflect modifications in the four functional areas.

A MODNET Hardware Service Report for use by the Hardware Engineering Technicians to record installation, modification, maintenance, and testing activities was designed and produced in multiparts on carbonless paper. A MODNET Software Service Report was prepared for use by Software Systems Engineering personnel.

The Documentation Section provided support throughout the life of the contract in the areas of writing, editing, and graphics in preparation of the following documents and reviews:

- Augmented Project Management Plan
- Hardware and Software Maintenance Plan
- Configuration Management and Quality Assurance Plan
- Implementation and Transition Plan

- System Requirements Review/Preliminary Design Review (SRR/PDR)
- Preliminary Design Document
- Critical Design Review
- Critical Design Document
- Master Test Plan with Acceptance Test Plan
- Operational Readiness Review
- Training Plan
- Interface Control Document
- Detailed Design Document
- Acceptance Test Procedures and Acceptance Test Report
- BFX Training Class Materials
- NMS3 Training Class Materials



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ATTACHMENT 1

PURCHASE ORDER

TECHNOLOGIES, INC.

8201 Corporate Drive • Suite 500  
Landover, Maryland 20785  
(301) 459-8981

PURCHASE ORDER NUMBER

18193

DATE 9/12/88

REQ # 3610

SELLER:

Network Systems Corporation  
501 Church Street, N.E., Suite 200  
Vienna, VA 22180

ATTN: Mr. Dennis Robertson

YASK-SUBTASK  
612.30.0000.621

DEPT - ACCT NO.  
312

SHIP TO: (IF NOT ABOVE ADDRESS)

Receiving Officer, Bldg. 16  
Goddard Space Flight Center  
Greenbelt, Maryland 20771  
MARK FOR: Steven A. Smith, Code 541.2  
Contract No. MAS5-30168

Items 1 thru 4 to be purchased at GSA Discount Prices

SHIP	best way	F.O.B.	delivered	TERMS	n/30	REQUIRED DELIVERY	asap
DELIVER TO:	MARK FOR:	GENERAL DESCRIPTION				MINORITY - 1	
	Steven A. Smith, Code 541.2	MODNET CONTRACT				SMALL BUSINESS - 2	
						OTHER - 3	

SELLER SHALL RETURN ACKNOWLEDGMENT AT ONCE, GIVING DEFINITE SHIPPING DATE.

ITEM NO.	QUANTITY	UNIT	DESCRIPTION	UNIT PRICE	TOTAL PRICE
1	4	ea	AT50 Trunk Expansion	\$4,329.00	\$17,316.00
2	2	ea	C223-1 A222 to A223 Conversion	\$1,380.00	2,760.00
3	1	ea	CN135 Network Administrator	13,340.00	13,340.00
4	2	sets	PI17-5 PI Extension Cables	754.00	1,508.00
5	2	sets	301419-xx Cable Assy., Interconnect	650.00	1,300.00
Terms and conditions on the reverse side of this PO are deleted. GSA terms and conditions will be the controlling terms. Items 2 and 3 should be installed by NSC within 30 days after they are received at GSFC.				TOTAL	\$36,224.00

THIS CONTRACT (PURCHASE ORDER) IS SUBJECT TO THE PROVISIONS ON BOTH SIDES AND ANY ATTACHMENTS IF IDENTIFIED ABOVE

SELLER SHALL:

- 1) INVOICE IN TRIPLICATE UNLESS OTHERWISE SPECIFIED
- 2) INCLUDE PACKING SLIP WITH EACH SHIPMENT
- 3) MAIL SHIPPING NOTICE TO SHIPPING DEPT.
- 4) PUT PURCHASE ORDER NUMBER ON ALL PACKAGES, PACKING SLIPS, BILLS OF LADING, AND INVOICES
- 5) MAIL ALL INVOICES TO: TREVOSE ACCOUNTS PAYABLE DEPT. AT ABOVE ADDRESS

NOTICE: TO BE VALID, A PURCHASE ORDER TOTALING \$25,000 OR MORE MUST BE COUNTERSIGNED BY THE DIRECTOR OF CONTRACTS.

PURCHASING AGENT

DIRECTOR OF CONTRACTS

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ATTACHMENT 2

PURCHASE ORDER



TECHNOLOGIES, INC.

8201 Corporate Drive • Suite 500  
Landover, Maryland 20785  
(301) 459-8981

PURCHASE ORDER NUMBER

18109-1

DATE 9/30/88

REQ # 4329

SELLER:

Sektremis, Inc.  
700 Professional Drive  
Gaithersburg, MD 20877

ATTN: Beverly Ryan

TASK-SUBTASK  
622.30.0000.421

DEPT-ACCT NO.  
312

SHIP TO: (IF NOT ABOVE ADDRESS)

Receiving Officer, Bldg. 16  
Goddard Space Flight Center  
Greenbelt, Maryland 20771  
MARK FOR: Steven A. Smith, Code 541.2  
Contract No. NAS-30168

SHIP	best way	F.O.B.	delivered	TERMS	a/30	REQUIRED DELIVERY	asap
DELIVER TO:	MARK FOR: Steven A. Smith, Code 541.2		GENERAL DESCRIPTION MODERN Contract NAS-30168			MINORITY - 1 SMALL BUSINESS - 2 OTHER - 3	

SELLER SHALL RETURN ACKNOWLEDGMENT AT ONCE, GIVING DEFINITE SHIPPING DATE

ITEM NO.	QUANTITY	UNIT	DESCRIPTION	UNIT PRICE	TOTAL PRICE
			Value of Original Purchase Order #18109		\$6,061.50
			Modification #1		
			Addition		
			GRFC Discount 5.00%		\$300.08
			Net Decrease to original Purchase Order #18109 is \$300.08.		
			This order is placed under written authorization from NASA dated June 8, 1988. In the event of any inconsistency between the terms and conditions of this order and those of your Federal Supply Schedule contract, or Personnel Property Rehabilitation Price Schedule contract, the latter will govern.		
			TOTAL		\$5,761.42

THIS CONTRACT (PURCHASE ORDER) IS SUBJECT TO THE PROVISIONS ON BOTH SIDES AND ANY ATTACHMENTS IF IDENTIFIED ABOVE

SELLER SHALL:

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- 5) MAIL ALL INVOICES TO: TREVISE ACCOUNTS PAYABLE DEPT. AT ABOVE ADDRESS

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PURCHASING AGENT

DIRECTOR OF CONTRACTS

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ATTACHMENT 3

PURCHASE ORDER

**IMS TECHNOLOGIES, INC.**

8201 Corporate Drive • Suite 500  
Landover, Maryland 20785  
(301) 459-8981

SELLER:

Informax Data Systems, Inc.  
5933 W. Century Blvd., Suite 610  
Los Angeles, CA 90045  
ATTN: David R. Brown

PURCHASE ORDER NUMBER

18216

DATE 9/30/88

REQ # 4305 and 4306

TASK-SUBTASK	DEPT - ACCT NO.
612.40.0000.621	312

SHIP TO: (IF NOT ABOVE ADDRESS)

Receiving Officer, Bldg. 16  
Goddard Space Flight Center  
Greenbelt, Maryland 20771  
MARK FOR: Steven A. Smith, Code 541.2  
Contract No. NAS5-30168

SHIP	F.O.B.	TERMS	REQUIRED DELIVERY
best way	delivered	n/30	asap
DELIVER TO:	GENERAL DESCRIPTION		PRIORITY - 1 <input type="checkbox"/> SMALL BUSINESS - 2 <input type="checkbox"/> OTHER - 3 <input type="checkbox"/>
MARK FOR: Steven A. Smith, Code 541.2	MODNET Contract NAS5-30168		

SELLER SHALL RETURN ACKNOWLEDGMENT AT ONCE, GIVING DEFINITE SHIPPING DATE

ITEM NO.	QUANTITY	UNIT	DESCRIPTION	UNIT PRICE	TOTAL PRICE
1	6	ea	3280 HEP Diagnostic Program for running Hyper-channel Exerciser Program (HEP) on NSC Model A400 Adapter Systems from Concurrent Computer Corporation - Perkin Elmer Model 3250 and 3280 computer systems, as per Informax Data Systems, Inc. (IDS) letter L-3766, dated 16 September 1988 and NSC HEP Design Specification Document 43999049B. In addition, the 3280 HEP must be compatible with the PASCAL compiler currently installed on the GSFC Code 510 Perkin-Elmer computers.	\$4,000.00	\$24,000.00
2	6	ea	Installation charge- The installation charge is limited to \$1,800.00 (5 days). Any costs over this must be borne by IDS.	\$300.00	\$1,800.00
3	6	ea	Product Maintenance- 1 year The Product Maintenance fee for 5 years is called out in letter L-3766. Only one year of maintenance will be purchased, at this time. The remaining 4 years of maintenance will be negotiated on an annual basis between NASA/GSFC or their contractor representative and IDS.	\$400.00	\$2,400.00
TOTAL					\$28,200.00

THIS CONTRACT (PURCHASE ORDER) IS SUBJECT TO THE PROVISIONS ON BOTH SIDES AND ANY ATTACHMENTS IF IDENTIFIED ABOVE

SELLER SHALL:

- 1) INVOICE IN TRIPLICATE UNLESS OTHERWISE SPECIFIED
- 2) INCLUDE PACKING SLIP WITH EACH SHIPMENT
- 3) MAIL SHIPPING NOTICE TO SHIPPING DEPT.
- 4) PUT PURCHASE ORDER NUMBER ON ALL PACKAGES, PACKING SLIPS, BILLS OF LADING, AND INVOICES
- 5) MAIL ALL INVOICES TO: TREVISE ACCOUNTS PAYABLE DEPT. AT ABOVE ADDRESS

NOTICE: TO BE VALID, A PURCHASE ORDER TOTALING \$25,000 OR MORE MUST BE COUNTERSIGNED BY THE DIRECTOR OF CONTRACTS.

PURCHASING AGENT

DIRECTOR OF CONTRACTS

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ATTACHMENT 4

PURCHASE ORDER

**RMS TECHNOLOGIES, INC.**

8201 Corporate Drive • Suite 500  
Landover, Maryland 20785  
(301) 459-8981

PURCHASE ORDER NUMBER

18217

DATE 9/30/88

REQ # 4309

SELLER:

Informax Data Systems, Inc.  
5933 W. Century Blvd., Suite 610  
Los Angeles, CA 90045

ATTN: Mr. David Brown

TASK-SUBTASK DEPT - ACCT NO.  
612.40.0000.621 312

SHIP TO: (IF NOT ABOVE ADDRESS)

Receiving Officer, Bldg. 16  
Goddard Space Flight Center  
Greenbelt, Maryland 20771  
MARK FOR: Steven A. Smith, Code 541.2  
Contract No. NAS5-30168

SHIP best way	F.O.B. delivered	TERMS n/30	REQUIRED DELIVERY asap
DELIVERTO: MARK FOR: Steven A. Smith, Code 541.2	GENERAL DESCRIPTION MODNET Contract NAS5-30168	MINORITY - 1 SMALL BUSINESS - 2 OTHER - 3 <input type="checkbox"/>	

SELLER SHALL RETURN ACKNOWLEDGMENT AT ONCE, GIVING DEFINITE SHIPPING DATE.

ITEM NO.	QUANTITY	UNIT	DESCRIPTION	UNIT PRICE	TOTAL PRICE
1	3	ea	32/77 HEP Diagnostic Program for running Hyper-channel Exerciser Program (HEP) on NSC Model A400 Adapter System from Gould Model SEL 32/77 Computer Systems, as per Informax Data Systems, Inc. (IDS) letter L-3766, dated 16 September 1988 and NSC HEP Design Specifications Document - 43999049B.	\$4,000.00	\$12,000.00
2	3	ea	Product Maintenance for 5 years		No Charge
3	3	ea	Engineering (NRE)	\$3,642.16	\$10,926.48
4	3	ea	Installation charge- The installation charge is limited to \$1,800.00 (5 days). Any costs over this must be borne by IDS.	\$600.00	\$1,800.00
TOTAL ▶					\$24,726.48

THIS CONTRACT (PURCHASE ORDER) IS SUBJECT TO THE PROVISIONS ON BOTH SIDES AND ANY ATTACHMENTS IF IDENTIFIED ABOVE.

SELLER SHALL:

- 1) INVOICE IN TRIPLICATE UNLESS OTHERWISE SPECIFIED
- 2) INCLUDE PACKING SLIP WITH EACH SHIPMENT
- 3) MAIL SHIPPING NOTICE TO SHIPPING DEPT.
- 4) PUT PURCHASE ORDER NUMBER ON ALL PACKAGES, PACKING SLIPS, BILLS OF LADING, AND INVOICES
- 5) MAIL ALL INVOICES TO: TREVISE ACCOUNTS PAYABLE DEPT. AT ABOVE ADDRESS

NOTICE: TO BE VALID, A PURCHASE ORDER TOTALING \$25,000 OR MORE MUST BE COUNTERSIGNED BY THE DIRECTOR OF CONTRACTS.

PURCHASING AGENT

DIRECTOR OF CONTRACTS

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## PREPARATION OF THE REPORT DOCUMENTATION PAGE

The last page of a report facing the third cover is the Report Documentation Page, RDP. Information presented on this page is used in announcing and cataloging reports as well as preparing the cover and title page. Thus it is important that the information be correct. Instructions for filling in each block of the form are as follows:

**Block 1. Report No.** NASA report series number, if preassigned.

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**Block 3. Recipient's Catalog No.** Reserved for use by each report recipient.

**Block 4. Title and Subtitle.** Typed in caps and lower case with dash or period separating subtitle from title.

**Block 5. Report Date.** Approximate month and year the report will be published.

**Block 6. Performing Organization Code.** Leave blank.

**Block 7. Author(s).** Provide full names exactly as they are to appear on the title page. If applicable, the word editor should follow a name.

**Block 8. Performing Organization Report No.** NASA installation report control number and, if desired, the non-NASA performing organization report control number.

**Block 9. Performing Organization Name and Address.** Provide affiliation (NASA program office, NASA installation, or contractor name) of authors.

**Block 10. Work Unit No.** Provide Research and Technology Objectives and Plans (RTOP) number.

**Block 11. Contract or Grant No.** Provide when applicable.

**Block 12. Sponsoring Agency Name and Address.** National Aeronautics and Space Administration, Washington, D.C. 20546-0001. If contractor report, add NASA installation or HQ program office.

**Block 13. Type of Report and Period Covered.** NASA formal report series; for Contractor Report also list type (interim, final) and period covered when applicable.

**Block 14. Sponsoring Agency Code.** Leave blank.

**Block 15. Supplementary Notes.** Information not included elsewhere: affiliation of authors if additional space is re-

quired for block 9, notice of work sponsored by another agency, monitor of contract, information about supplements (film, data tapes, etc.), meeting site and date for presented papers, journal to which an article has been submitted, note of a report made from a thesis, appendix by author other than shown in block 7.

**Block 16. Abstract.** The abstract should be informative rather than descriptive and should state the objectives of the investigation, the methods employed (e.g., simulation, experiment, or remote sensing), the results obtained, and the conclusions reached.

**Block 17. Key Words.** Identifying words or phrases to be used in cataloging the report.

**Block 18. Distribution Statement.** Indicate whether report is available to public or not. If not to be controlled, use "Unclassified-Unlimited." If controlled availability is required, list the category approved on the Document Availability Authorization Form (see NHB 2200.2, Form FF427). Also specify subject category (see "Table of Contents" in a current issue of STAR), in which report is to be distributed.

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**APPENDIX A**

**MODNET HARDWARE/SOFTWARE DATA BASES**

# Report Documentation Page

1. Report No.  16		2. Government Accession No.		3. Recipient's Catalog No.	
4. Title and Subtitle  Final Report for the Mission Operations & Data Systems Directorate's Operational Development Network (MODNET) at Goddard Space Flight Center				5. Report Date  October 31, 1988	
				6. Performing Organization Code	
7. Author(s)  RMS Technologies, Inc. 8201 Corporate Drive Landover, MD 20785				8. Performing Organization Report No.	
				10. Work Unit No.	
9. Performing Organization Name and Address  RMS Technologies, Inc. 8201 Corporate Drive Landover, MD 20785				11. Contract or Grant No.  NAS5-30168	
				13. Type of Report and Period Covered  Final Report June 1, 1987-Sept. 30, 1988	
12. Sponsoring Agency Name and Address  National Aeronautics and Space Administration Washington, D.C. 20546-0001 Goddard Space Flight Center Greenbelt, MD 20771				14. Sponsoring Agency Code	
15. Supplementary Notes					
16. Abstract  This report provides a brief, informal narrative that summarizes the results of all work accomplished during the period of the contract; June 1, 1987 through September 30, 1988; in support of MODNET. It includes descriptions of work performed in each functional area and recommendations and conclusions based on the experience and results obtained.					
17. Key Words (Suggested by Author(s))				18. Distribution Statement  Unclassified-Unlimited	
19. Security Classif. (of this report)  Unclassified		20. Security Classif. (of this page)  Unclassified		21. No. of pages  25	
				22. Price	